

## SETAL MORPHOLOGY OF THE OLIGOCHAETES *TUBIFEX TUBIFEX* AND *ILYODRILUS FRANTZI* (*CAPILLATUS*) AS REVEALED BY SEM

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*Abstract.*—Scanning electron microscope observations of *Tubifex tubifex* reveal details of the serrations on hairs, pectinations on dorsal setae, and more extensive pectinations on the ventral setae than previously described. Lack of serrations on *Ilyodrilus frantzi* (*capillatus*) hairs is documented as are details of dorsal setal pectinations. Three new features of this species are shown: the concave nature of the upper and lower setal teeth, pectinate ventral setae, and an apparent ability to retract setal bundles.

Scanning Electron Microscopy (SEM) is an extremely valuable technique for establishing and documenting, at a greater level of resolution than is possible with light microscopy, the presence of fine differences in organism morphology. Previous uses of SEM with oligochaetes include documentation of external sense organs (Chapman 1979; Smith 1983) and of fine setal differences in two species of Naididae (Smith 1985). In previous studies (Chapman and Brinkhurst, in press; Brinkhurst and Chapman, in prep.), we used the SEM technique to document setal variations inducible in naeidid and tubificid oligochaetes under varying environmental conditions. As a result of these previous studies, we obtained various new descriptive observations on the structure of the setae of *Tubifex tubifex* and *Ilyodrilus frantzi* (*capillatus*) which are provided herein, related to taxonomic descriptions of these species.

### Materials and Methods

*Tubifex tubifex* specimens were collected from the Fraser River, B.C.; *I. frantzi* (*capillatus*) specimens were collected from the Fraser River and from the Columbia River, Oregon. Worms were fixed in cold 3% buffered glutaraldehyde, washed in 0.1 M phosphate buffer and post-fixed in 1% buffered

osmium tetroxide for ½ h at room temperature. Specimens were then washed in 0.1 M phosphate buffer and dehydrated through an ascending ethanol series before being critical-point dried with CO<sub>2</sub>, mounted on aluminum stubs, and sputter coated with gold. A Cambridge S100 Stereoscan Scanning Electron Microscope was used for viewing.

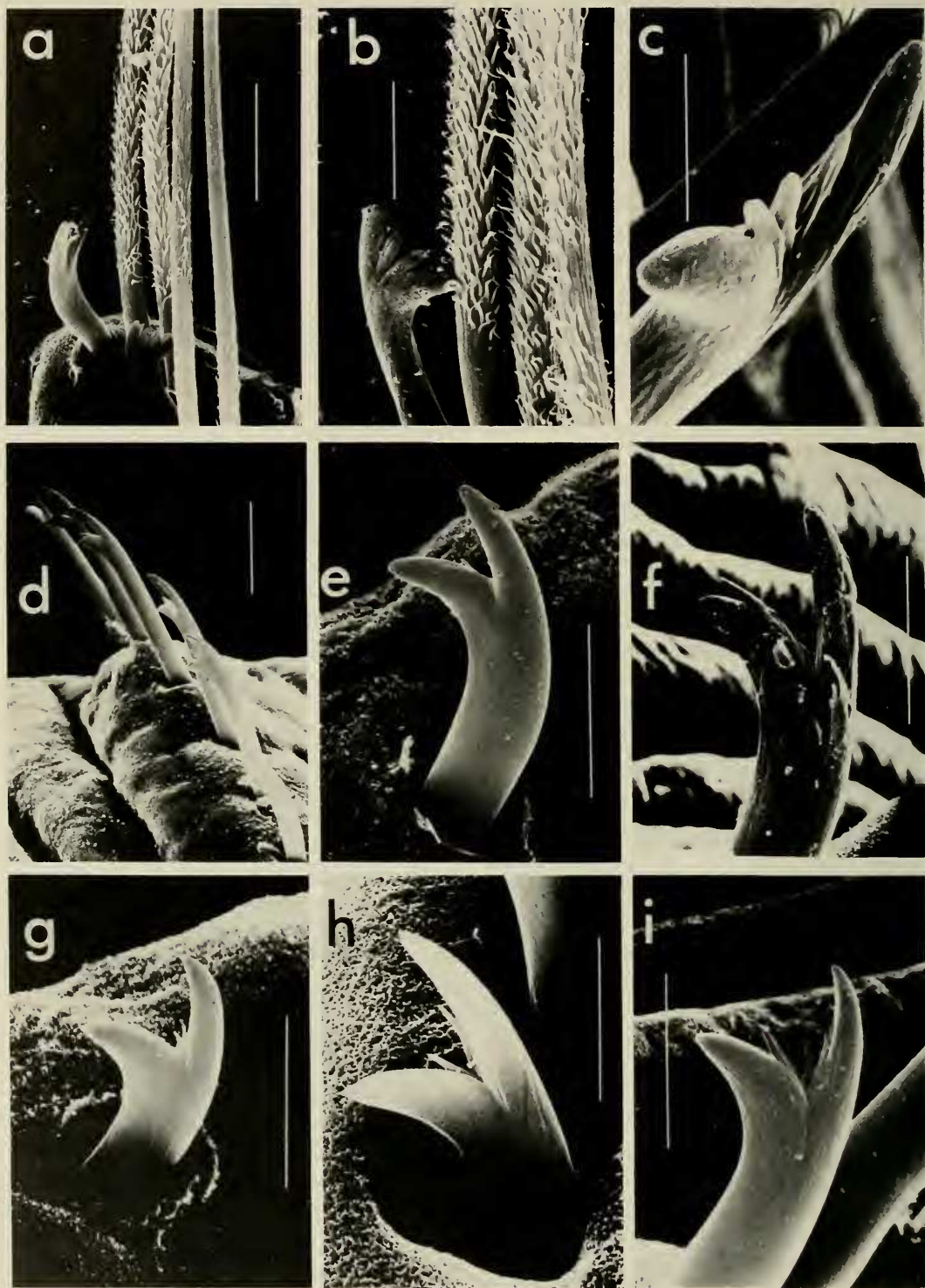
### Results

Details of serrations on *T. tubifex* hairs, pectinations of dorsal setae, and pectinations of ventral setae, are provided in Fig. 1. Hairs in the same setal bundle can vary from virtually non-serrate to heavily serrate. Similarly, the degree of ventral setal pectination is highly variable, even within the same bundle and can approach the dorsal setal condition.

Details of hairs, dorsal and ventral setae of *I. frantzi* (*capillatus*) are provided in Fig. 2. Hairs are shown to be essentially non-serrate. Dorsal and ventral setae have concave outer teeth, may have varying degrees of pectination, and can apparently be retracted.

### Discussion

*Tubifex tubifex.*—*T. tubifex* are described as having serrate or non-serrate hairs



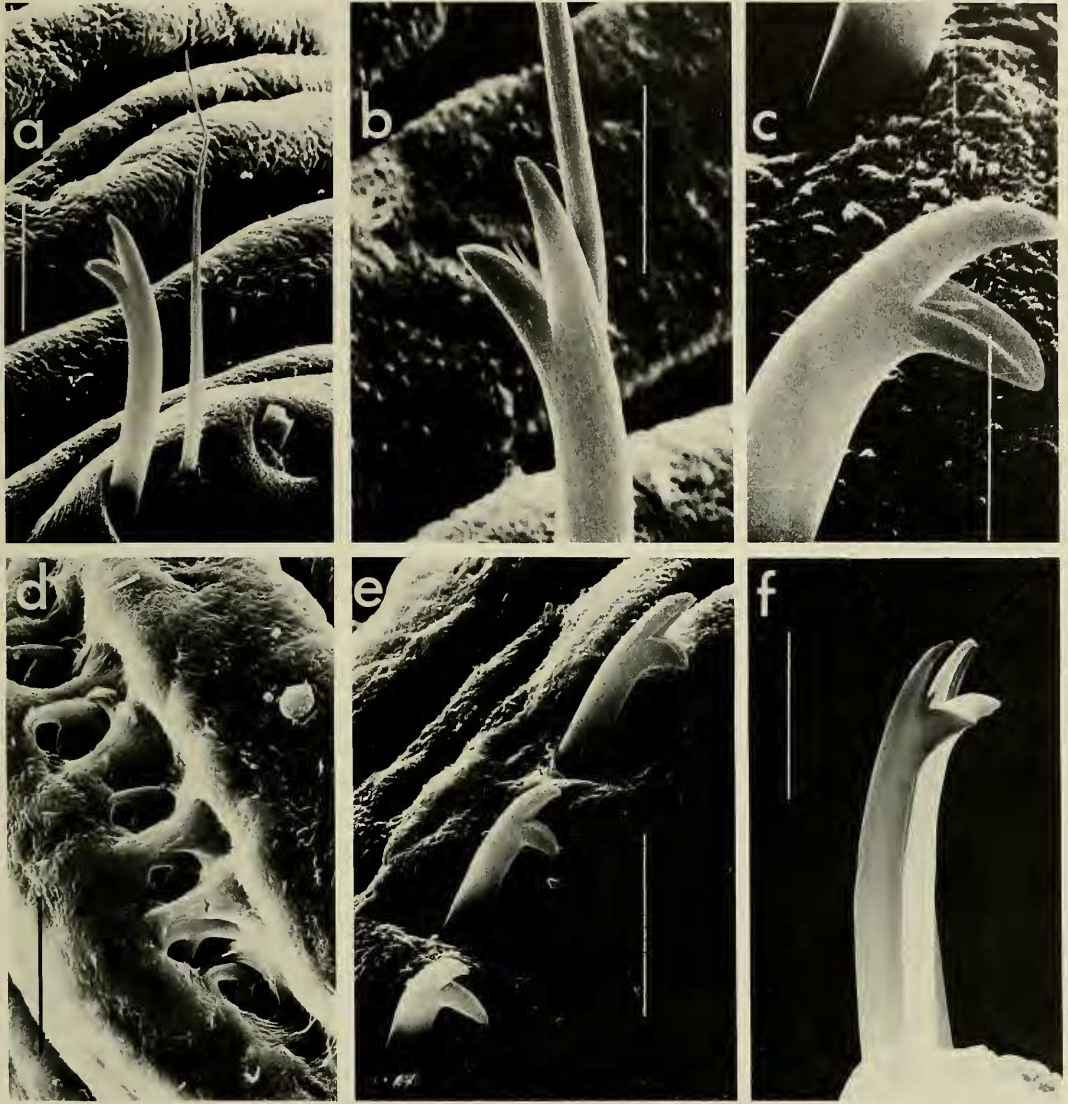


Fig. 2. Details of setal morphology of *Ilyodrilus frantzi* (*capillatus*): a–b, Variable amounts of dorsal pectination, hairs show only traces of serrations; c, Detail of dorsal pectinate seta showing concave lower tooth (upper tooth is similar); d, Retracted, non-pectinate dorsal setae; e, Non-pectinate ventral setae; f, Pectinate ventral seta. Scale bars 10  $\mu\text{m}$  for b and c, 20  $\mu\text{m}$  for a and d to f.

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Fig. 1. Details of setal morphology of *Tubifex tubifex*: a–b, Variable amounts of serrations on dorsal hairs, note serrations begin around top of pectinate setae; c, Detail of dorsal pectinate seta; d–i, Ventral pectinations observed in various specimens. Scale bars 5  $\mu\text{m}$  for c, 10  $\mu\text{m}$  for a and d, 20  $\mu\text{m}$  for b and e to i.

(Brinkhurst and Jamieson 1979; Brinkhurst 1982; Brinkhurst, 1986). The nature of these serrations, as documented in Fig. 1a–b, is variable even within a single dorsal bundle, which may simply reflect differential exposure to abrasion or other environmental factors causing shredding. SEM photographs indicate that the observed serrations are due to shredding; serrations generally begin immediately distal to the top of the dorsal setae, suggesting that the setae provide some measure of protection against abrasion. The hypothesis of serrations being formed through shredding was first advanced by Smith (1985), for *Dero* spp. Since serrations appear to be a variable characteristic, probably influenced by environmental conditions, their use in oligochaete taxonomy should be discontinued.

The nature of dorsal setal pectination is illustrated (Fig. 1a–c). Pectinations have approximately equal lateral teeth shorter in length than the upper and lower setal teeth.

The degree and variability of pectination possible on ventral setae is large (Fig. 1d–h). The degree of pectination can vary within a single bundle (Fig. 1d), and shows a range including single (Fig. 1e–f), bifid (Fig. 1g–h) and trifid pectinations (Fig. 1i). The degree of ventral pectination may approximate that seen dorsally (compare Fig. 1c and 1i) and is shown to be more extensive than that described by Brinkhurst and Jamieson (1971:455), “rarely with a single intermediate tooth,” Brinkhurst (1982:40), “sometimes a few short intermediate teeth on ventral setae,” or Brinkhurst (1986:149), “sometimes with a small intermediate tooth.”

*Ilyodrilus frantzi (capillatus)*.—Descriptions of *I. frantzi (capillatus)* have not included lateral serrations on hairs. This lack of serrations is confirmed by SEM (Fig. 2a–b).

Brinkhurst (1978) provided the first report of dorsal pectinate setae; Brinkhurst (1986:173) states that there are a “few pec-

tinate setae” dorsally. Dorsal setae may have none, one (Fig. 2a), or two pectinations (Fig. 2b).

SEM reveals that the inner surfaces of the setae of *I. frantzi capillatus* have gutter-shaped (concave) upper and lower teeth (Fig. 2c, e–f). Apparently setal bundles can be retracted (Fig. 2d). These features have not previously been described for this or for any other aquatic oligochaete.

The presence of ventral pectinations was suspected by Brinkhurst (1978:2173) who noted that the ventral setae in some specimens “seem to be slightly ornamented, but this needs confirmation by scanning electron microscopy.” Such confirmation is now provided. Ventral setae may be apectinate (Fig. 2e), or may have a single intermediate pectination (Fig. 2f).

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